

NASA Electronic Parts and Packaging (NEPP)

A NASA Office of Safety and Mission Assurance (OSMA) Program

Kenneth A. LaBel ken.label@nasa.gov 301-286-9936 Co- Manager, NEPP Program NASA/GSFC



Acronyms

Acronym	Definition
3D	Three Dimensional
AF	Air Force
AF SMC	Air Force Space and Missile Systems Center
Al	Artificial Intelligence
BAE	BAE Systems
BOK	Body of Knowledge
BYU	Brigham Young University
CLTs	NASA CIO Leadership Teams
CMOS	Complementary Metal Oxide Semiconductor
COTS	Commercial Off The Shelf
DDR	Double Data Rate (DDR3 = Generation 3; DDR4 = Generation 4)
DiRAM	Dis-integrated Random Access Memory
DLA	Defense Logistics Agency
DoD	Department of Defense
DOE	Department of Energy
DRAM	Dynamic Random-Access Memory
EEE	Electrical, Electronic, and Electromechanical
ESA	European Space Agency
FinFETs	Fin Field Effect Transistors
FPGA	Field Programmable Gate Array
GaN	Gallium Nitride
GIDEP	Government-Industry Data Exchange Program
GPU	Graphics Processing Unit
IC	Integrated Circuit
IR	Infrared
JEDEC	Joint Electron Device Engineering Council (JEDEC)

Acronym	Definition
LANL	Los Alamos National Laboratories
MBMA	Model-Based Missions Assurance
Mil	Military
MOSFET	Metal-Oxide-Semiconductor Field-Effect Transistor
MPSOC	Multi-Processing System on Chip
NASA	National Aeronautics and Space Administration
Navy Crane	Naval Surface Warfare Center, Crane, Indiana
Navy Crane	Naval Surface Warfare Center, Crane Division
NEPAG	NASA EEE Parts Assurance Group
NEPP	NASA Electronic Parts and Packaging
NESC	NASA National Electric Safety Code
NRO	United States Navy National Reconnaissance Office
OCE	Office of the Chief Engineer
OSMA	NASA Office of Safety and Mission Assurance (OSMA) Program
R&M	Reliability and Maintainability
RH	Radiation Hardened
SAE	Society of Automotive Engineers (SAE)
SAPP	Space Asset Protection Program
SEB	Single Event Burnout
SEE	Single Event Effect
SiC	Silicon Carbide
SME	Small and Medium-sized Enterprises
SNL	Sandia National Laboratories
SOC	Systems on a Chip
STMD	NASA's Space Technology Mission Directorate
TOR	Technical Operating Report



NEPP Mission Statement

Provide NASA's leadership for developing and maintaining guidance for the screening, qualification, test, and reliable usage of electrical, electronic, and electromechanical (EEE) parts by NASA, in collaboration with other government Agencies and industry.



NEPP - Charter

Agency Priorities – Independent Support

- Commercial Crew
- •Small Mission Reliability
- Coordination with NASA Consolidation, CLTs, NESC, STMD, SAPP, and radiation block buy
- Collaborate with DoD/DOE on space radiation test infrastructure

Technology Evaluation

- Advanced /new EEE parts/technologies
- •Ex. Advanced CMOS, GaN, SiC
- Working Groups (NASA , government, aerospace)
- Screening/qualification/ test/usage guidelines
- Partnering: NASA,
 Government Agencies,
 Industry, University,
 International

Trusted and RH Electronics

- Collaboration with NASA and other Agency Supply Chain and Trust/Counterfeit Electronics Organizations
- Support DoD efforts on Trusted Foundries and FPGAs (w/NASA STMD and OCE/Space Asset Protection)
- •Support DoD RH efforts

Agency Leadership

EEE Parts

Infrastructure

Working Groups

SME Capabilities

NEPAG Telecons and

Communication and

and to the greater

Outreach within NASA

aerospace community

- •NASA Policies and Procedures
- Agency Guidelines, Body of Knowledge (BOK) documents, and Best Practices
- Coordination of Government and Industry Standards
- Audit Coordination with AF, NRO, DLA
- Partnering within NASA and other Agencies, Industry, University, and International

Mission Assurance

EEE Parts Problem Investigations

- Agency/Industry-wide problems
- GIDEP and NASA Alert development

Body of Knowledge (BOK) Documents

What goes into a BOK

- An overview of the technology
- An overview of technology applicability to space/aeronautics
- An overview of technology maturity, produceability and/or commercial availability
- Reliability, qualification, and/or radiation knowledge-base
- Technology direction or extent of the reliability issue for the future Identification of experts, technology sources, test houses, etc.
- Facilities/capabilities
- Recommendation for follow-on NEPP task (if applicable)

BODY OF KNOWLEDGE FOR SILICON CARBIDE POWER ELECTRONICS



NEPP – Product Delivery

Best Practices and Guidelines

- Test, usage, screening, qualification
- Radiation facility studies

NASA EEE Parts
Policy and
Standards

Government and Industry Standards Representation

- SAE G11/G12/ JEDEC JC13
- Aerospace TORs

BOK

 Technology and product status and gap analysis

Assurance

NEPP Standard Products

- Test, summary, and audit reports
- Conference and workshop presentations
- Alerts

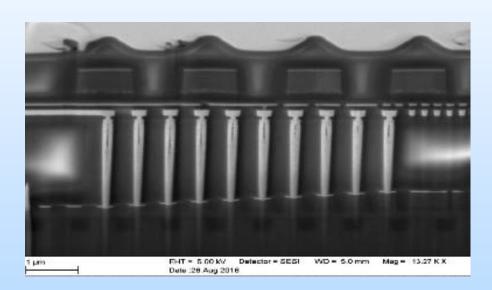
Related task areas:

Technology/parts evaluations lead to new best practices, etc...

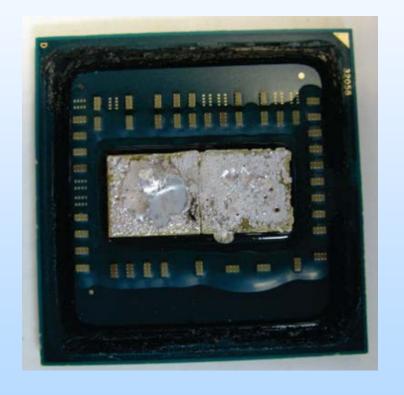


Advanced Technologies

 Technology/device evaluations with a nod to developing test methods and user guidance



Hynix 3D Flash Memory



AMD Ryzen Processor

NEPP – Processors, Systems on a Chip (SOC), and Field Programmable Gate Arrays (FPGAs)

State of the Art COTS Processors

- •Sub 32nm CMOS, FinFETs, etc
- •Samsung, Intel, AMD

"Space" FPGAs

- •Microsemi RTG4
- •Xilinx MPSOC+

(future)

•ESA Brave (future)
•"Trusted" FPGA

Graphics Processor Units (GPUs)

- •Intel, AMD, Nvidia
- Enabling data processing

COTS FPGAs

- Xilinx Kintex+
- Mitigation evaluation
- •TBD: Microsemi PolarFire

Radiation Hardened Processor Evaluation

- •BAE
- Vorago (microcontrollers)

Best
Practices
and
Guidelines

Partnering

- Processors: Navy Crane, BAE/NRO-
- •FPGAs: AF SMC, SNL, LANL, BYU,...
- Microsemi, Xilinx, Synopsis
- Cubic Aerospace

Potential future task areas:

artificial intelligence (AI) hardware, Intel Stratix 10



NEPP – Memories

New materials/ architectures

- Resistive
 - Fujitsu/Panasonic
- Spin torque transfer magnetoresistive
 - Avalanche, Everspin
- 3D Xpoint
 - Intel Optane
- Enabling "universal" memories

DRAMs

- DDR4 test capability (in progress)
- Commercial DDR (various)
- Tezzaron DiRAM
- Enabling high performance computing

Commercial Flash

- 3D
 - Samsung, Hynix, Micron
- Planar TBD
- Enabling data storage density

Best Practices and Guidelines

Partnering

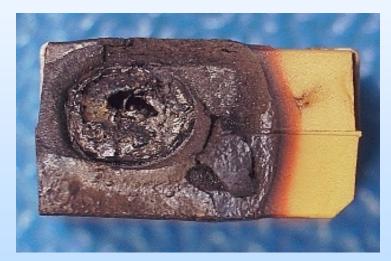
- Navy Crane
- NASA STMD
- Avalanche
- University of Padova

Related task areas:

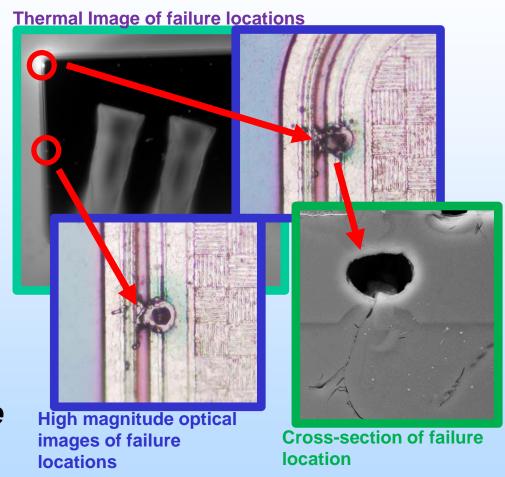
Deprocessing for single event testing (also w/processors, FPGAs,...)



Working Industry/Agency-Wide Concerns



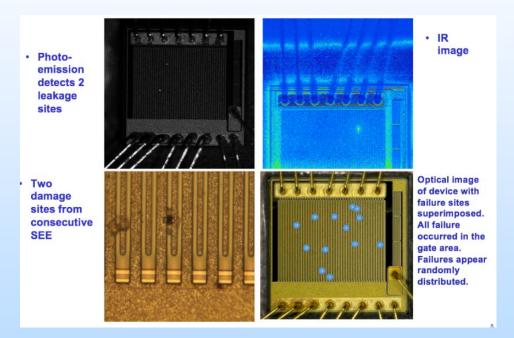
Tantalum capacitor failure



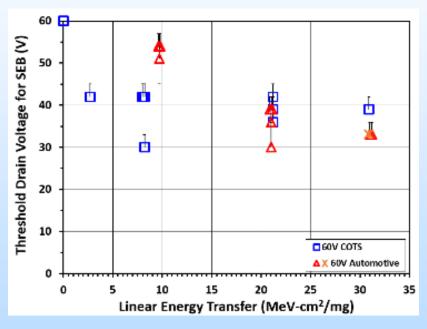
Failure analysis of Schottky diode radiation damage



Vendor Validation Tests



GaN IC - radiation test analysis



Comparison of n-type 60V trench MOSFET SEB thresholds



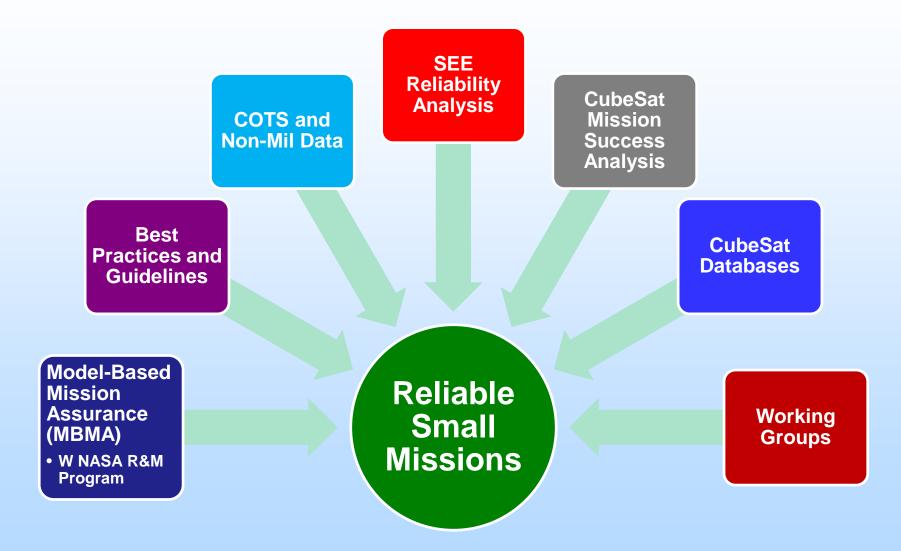
Infrastructure Challenges



Using Proton Cancer Therapy Centers for electronics testing



NEPP - Small Mission Efforts

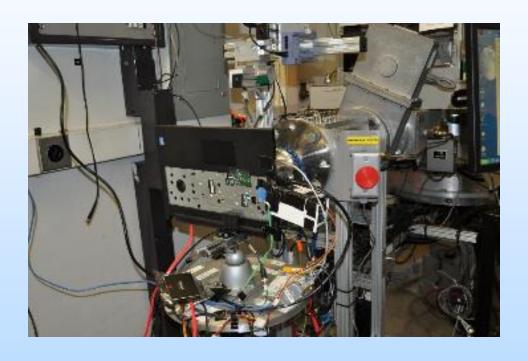


Potential future task areas: automotive and avionics resilience



Partnering is key

- Within
 - NASA
- With
 - Othergovernmentagencies
 - Industry
 - University
 - International





http://nepp.nasa.gov